CLAIMS

1. A finger/palm print image processing system comprising:

a frequency component analysis unit configured to perform a frequency analysis on each of plural small regions into which a finger/palm print image is divided, to obtain plural frequency components representing each of the plural small regions; and

a frequency component judgment unit configured to judge clarity of the small regions corresponding to the frequency components, based on the frequency components, wherein

said finger/palm print image indicates at least one of a finger print and a palm print.

2. The finger/palm print image processing system according to claim 1, wherein:

said frequency component analysis unit uses a Fourier transform as the frequency analysis; and

said frequency component judgment unit judges clarity of the small region corresponding to the frequency components, based on the frequency components and a result of subjecting a clear two-dimensional sinusoidal wave to a Fourier transform.

3. The finger/palm print image processing system according to claim 1 or 2, wherein

said frequency component analysis unit decides one point in a frequency space as the frequency components based on a result of the frequency analysis, and approximates the small region corresponding to the frequency components, to a representative point two-dimensional sinusoidal wave as a two-dimensional sinusoidal wave corresponding to the one

point in the frequency space.

4. The finger/palm print image processing system according to claim 3, wherein

said frequency component judgment unit judges clarity of the small region corresponding to the frequency components by use of a size of an amplitude of the representative point two-dimensional sinusoidal wave or by use of a ratio of the size of the amplitude of the representative point two-dimensional sinusoidal wave to a total sum of amplitudes of two-dimensional sinusoidal waves at a predetermined frequency band.

5. The finger/palm print image processing system according to claim 3 or 4, wherein

said frequency component judgment unit judges a small region to be a clear finger/palm print region if the small region satisfies either a condition that a size of an amplitude of the representative point two-dimensional sinusoidal wave is not smaller than a predetermined value or another condition that a value obtained by normalizing the size of the amplitude of the representative point two-dimensional sinusoidal wave of the small region by the greatest one among sizes of amplitude of the representative point two-dimensional sinusoidal waves of the plural small regions is not smaller than a predetermined value.

6. The finger/palm print image processing system according to claim 1 or 2, wherein:

said frequency component analysis unit obtains a first analysis result of performing a frequency analysis on a center portion of the small region, and a second analysis result of performing a frequency analysis on the small

region including peripheral portions; and

said frequency component judgment unit judges the small region to be a region having a fine structure if a difference exists between the first and second analysis results, or judges the small region to be a region having a monotonous flow if no difference exists between the first and second analysis results.

7.   The finger/palm print image processing system according to any one of claims 1 to 6, further comprising

an image quality judgment unit configured to judge quality of the finger/palm print image, based on judgment results of clarity of all the plural small regions.

8.   The finger/palm print image processing system according to claim 7, wherein:

said finger/palm print image is inputted from a finger/palm print image input device; and

said image quality judgment unit judges image quality of a predetermined number of finger/palm print images, to judge quality of the finger/palm print image input device.

9.   The finger/palm print image processing system according to any one of claims 1 to 6, further comprising

a ridgeline image extraction unit configured to change a method of extracting ridgelines from the finger/palm print image in the small region, based on the judgment result of clarity of the small region for each of the plural small regions, and to extract the ridgelines.

10.   The finger/palm print image processing system according to any one of claims 1 to 9, wherein

said frequency component analysis unit inputs the

finger/palm print image sequentially in units of the small regions, and performs the frequency analysis for each of the small regions.

11.   The finger/palm print image processing system according to any one of claims 1 to 9, wherein
said frequency component analysis unit inputs the entire finger/palm print image, divides the finger/palm print image into the small regions, and performs the frequency analysis.

12.   A finger/palm print image processing method comprising:
a step (a) of performing a frequency analysis on each of plural small regions into which a finger/palm print image is divided, to obtain plural frequency components representing each of the plural small regions, the finger/palm print image indicating at least one of a finger print and a palm print; and
a step (b) of judging clarity of the small regions corresponding to the frequency components, based on the frequency components.

13.   The finger/palm print image processing method according to claim 12, wherein:
said step (a) includes a step (a1) of using a Fourier transform as the frequency analysis; and
said step (b) includes a step (b1) of judging clarity of the small region corresponding to the frequency components, based on the frequency components and a result of subjecting a clear two-dimensional sinusoidal wave to a Fourier transform.

14.   The finger/palm print image processing method according to claim 12 or 13, wherein

said step (a) includes:

a step (a2) of deciding one point in a frequency space as the frequency components, based on a result of the frequency analysis; and

a step (a3) of approximating the small region corresponding to the frequency components, to a representative point two-dimensional sinusoidal wave as a two-dimensional sinusoidal wave corresponding to the one point in the frequency space.

15.   The finger/palm print image processing method according to claim 14, wherein

said step (b) includes a step (b2) of making a judgment either by use of a size of an amplitude of the representative point two-dimensional sinusoidal wave or by use of a ratio of the size of the amplitude of the representative point two-dimensional sinusoidal wave to a total sum of amplitudes of two-dimensional sinusoidal waves at a predetermined frequency band.

16.   The finger/palm print image processing method according to claim 14 or 15, wherein

said step (b2) includes a step (b21) of judging a small region to be a clear finger/palm print region if the small region satisfies either a condition that a size of an amplitude of the representative point two-dimensional sinusoidal wave is not smaller than a predetermined value or another condition that a value obtained by normalizing the size of the amplitude of the representative point two-dimensional sinusoidal wave of the small region by the greatest one among sizes of amplitude of the representative

point two-dimensional sinusoidal waves of the plural small regions is not smaller than a predetermined value.

17. The finger/palm print image processing method according to claim 12 or 13, wherein:

said step (a) includes a step (a4) of obtaining a first analysis result performing a frequency analysis on a center portion of the small region, and a second analysis result performing a frequency analysis on the small region including peripheral portions; and

said step (b) includes a step (b3) of judging the small region to be a region having a fine structure if a difference exists between the first and second analysis results, or judging the small region to be a region having a monotonous flow if no difference exists between the first and second analysis results.

18. The finger/palm print image processing method according to any one of claims 12 to 17, further comprising a step (c) of judging quality of the finger/palm print image, based on judgment results of clarity of all the plural small regions.

19. The finger/palm print image processing method according to claim 18, wherein:

said step (a) includes a step (a5) of obtaining the finger/palm print image from a finger/palm print image input device; and

said step (b) includes a step (b4) of judging image quality of a predetermined number of finger/palm print images, to judge quality of the finger/palm print image input device.

20. The finger/palm print image processing method according to any one of claims 12 to 17, further comprising a step (d) of changing, for each of the plural small regions, a method of extracting ridgelines from the finger/palm print image in the small region, based on the judgment result of clarity of the small region, and extracting the ridgelines.

21. The finger/palm print image processing method according to any one of claims 12 to 20, wherein said step (a) includes

a step (a6) of inputting the finger/palm print image sequentially in units of the small regions, and the frequency analysis is performed for each of the small regions.

22. The finger/palm print image processing method according to any one of claims 12 to 20, wherein said step (a) includes:

a step (a7) of inputting the entire finger/palm print image; and

a step (a8) of dividing the finger/palm print image into the small regions,

wherein said frequency analysis is performed for each of the small regions.

23. A program for making a computer execute a method, comprising:

a step (a) of performing a frequency analysis on each of plural small regions into which a finger/palm print image is divided, to obtain plural frequency components representing each of the plural small regions, said finger/palm print image indicating at least one of a finger

print and a palm print; and

a step (b) of judging clarity of the small regions corresponding to the frequency components, based on the frequency components.

24. The program according to claim 23, wherein:
said step (a) includes a step (a1) of using a Fourier transform as the frequency analysis; and
said step (b) includes a step (b1) of judging clarity of the small region corresponding to the frequency components, based on the frequency components and a result of subjecting a clear two-dimensional sinusoidal wave to a Fourier transform.

25. The program according to claim 23 or 24, wherein said step (a) includes:
a step (a2) of deciding one point in a frequency space as the frequency components, based on a result of the frequency analysis; and
a step (a3) of approximating the small region corresponding to the frequency components, to a representative point two-dimensional sinusoidal wave as a two-dimensional sinusoidal wave corresponding to the one point in the frequency space.

26. The program according to claim 25, wherein said step (b) includes a step (b2) of making a judgment either by use of a size of an amplitude of the representative point two-dimensional sinusoidal wave or by use of a ratio of the size of the amplitude of the representative point two-dimensional sinusoidal wave to a total sum of amplitudes of two-dimensional sinusoidal waves at a predetermined frequency band.

27. The program according to claim 25 or 26, wherein said step (b2) includes a step (b21) of judging a small region to be a clear finger/palm print region if the small region satisfies either a condition that a size of an amplitude of the representative point two-dimensional sinusoidal wave is not smaller than a predetermined value or another condition that a value obtained by normalizing the size of the amplitude of the representative point two-dimensional sinusoidal wave of the small region by the greatest one among sizes of amplitude of the representative point two-dimensional sinusoidal waves of the plural small regions is not smaller than a predetermined value.

28. The program according to claim 23 or 24, wherein:
said step (a) includes a step (a4) of obtaining a first analysis result performing a frequency analysis on a center portion of the small region, and a second analysis result performing a frequency analysis on the small region including peripheral portions; and
said step (b) includes a step (b3) of judging the small region to be a region having a fine structure if a difference exists between the first and second analysis results, or judging the small region to be a region having a monotonous flow if no difference exists between the first and second analysis results.

29. The program according to any one of claims 23 to 28, further comprising
a step (c) of judging quality of the finger/palm print image, based on judgment results of clarity of all the plural small regions.

30. The program according to claim 29, wherein:

said step (a) includes a step (a5) of inputting the finger/palm print image from a finger/palm print image input device; and

said step (b) includes a step (b4) of judging image quality of a predetermined number of finger/palm print images, to judge quality of the finger/palm print image input device.

31. The program according to any one of claims 23 to 28, further comprising

a step (d) of changing, for each of the plural small regions, a method of extracting ridgelines from the finger/palm print image in the small region, based on the judgment result of clarity of the small region, and extracting the ridgelines.

32. The program according to any one of claims 23 to 31, wherein

said step (a) includes

a step (a6) of inputting the finger/palm print image sequentially in units of the small regions, and said frequency analysis is performed for each of the small regions.

33. The program according to any one of claims 23 to 31, wherein

said step (a) includes:

a step (a7) of inputting the entire finger/palm print image; and

a step (a8) of dividing the finger/palm print image into the small regions,

wherein said frequency analysis is performed for each

of the small regions.